REMARKS

Claims 1-39 are currently pending in the application. Claims 22 and 23 are hereby amended and new claims 32-39 are added for Examiner's consideration. The foregoing separate sheets marked as "Listing of Claims" show all the claims in the application, with an indication of the current status of each.

Claim Rejections: 35 USC § 112, second paragraph

Claim 22 stands rejected under 35 USC § 112m second paragraph, as indefinite due the recitation of "said" formula 5 without at prior recitation of "formula 5". Claim 22 has hereby been amended by deleting the word "said" and adding formula 5, thereby overcoming this rejection.

In view of the foregoing, Applicant requests reconsideration and withdrawal of this objection.

Claim Rejections: 35 USC § 102(e): Examiner's Point #5

Claims 1, 5 and 10 stand rejected under 35 USC § 102(e) as anticipated by Gates (US 2005/0276930). This rejection is traversed.

Examiner states that, with respect to claim 1, the method of Gates includes a step of "introducing a gas containing vapor of cyclic organic silica compounds, which have silicon and oxygen skeletons and have at least one unsaturated hydrocarbon group bound with a side chain of a skeleton…" (underline added). This statement is incorrect. In fact, the teaching of Gates concerning the types of precursors to be utilized in the invention is found in paragraph [0052] of the published application, which states: "Preferably the first precursor is a siloxane containing Si, C, O and H atoms, with cyclic siloxanes being especially preferred. Examples of some highly preferred first precursors include siloxanes selected from molecules with ring structures such as 1,3,5,7-tetramethylcyclotetrasiloxane (TMCTS or $C_4H_{16}O_4Si_4$), octamethylcyclotetrasiloxane (OMCTS, $C_8H_{24}O_4Si_4$), tetraethylcyclotetrasiloxane ($C_8H_{24}O_4Si_4$), decamethylcyclopentasiloxane ($C_{10}H_3O_5Si_5$), trimethylcyclotrisiloxane, hexamethylcyclotrisiloxane, molecules of methylsilanes mixed with an oxidizing agent such as O_2 or N_2O or precursor mixtures including Si, O and C." Applicant notes that silicon and oxygen skeletons that have at least one **unsaturated** hydrocarbon group bound with a side chain of a skeleton are not taught by Gates. In contrast, the present invention requires that an unsaturated

hydrocarbon group be attached to the silicon/oxygen skeleton of the gas that is used to make the porous insulating film of the invention (see claims 1 and 3; and see also claims 6 and 7 where the unsaturated vinyl group is shown).Therefore, Gates does not anticipate the present invention as claimed in claims 1, 5 and 10.

In view of the foregoing, Applicant respectfully requests reconsideration and withdrawal of this rejection.

Claim Rejections: 35 USC § 102(e): Examiner's Point #6

Claims 2-4, 18, 30, and 31 stand rejected under 35 USC § 102(e) as anticipated by Gates (US 2005/0276930). This rejection is traversed.

As established above, Gates does not teach a gas containing vapor of cyclic organic silica compounds, which have silicon and oxygen skeletons and have at least one unsaturated hydrocarbon group bound with a side chain of a skeleton. The full extent of Gates teaching regarding a precursor gas is found in paragraph [0052] and does not include unsaturated hydrocarbon groups bound to the side chain of the silica-carbon skeleton. Thus, Gates does not anticipate the subject matter of the present invention, as claimed in claims 2-4, 18, 30, and 31.

In view of the foregoing, Applicant respectfully requests reconsideration and withdrawal of this rejection.

Claim Rejections: 35 USC § 102(e): Examiner's Point #7

Claims 23, 27 and 29 stand rejected under 35 USC § 102(e) as anticipated by Fujita (US 2004/0135254). This rejection is traversed.

Claim 23 has hereby been amended to recite a porous insulating film having a distribution of pore diameter with a single peak, wherein the specific inductive capacity is equal to or greater than 2.1 and equal to or smaller than 2.7, and wherein pores within said porous insulating film are enclosed within silica skeletons formed from polymerized cyclic organic silica molecules. Support for this feature is found, for example, in pargraph [0045] of the published application, and thus does not add any new matter. Claim 27 recites the porous insulating film of claim 23, in which a maximum average pore diameter is equal to or smaller than 1 nm; and claim 29 recites a semiconductor device in which the porous insulating film of claim 23 is used as a layer insulating film.

Fujita addresses the problem of how to provide a porous insulating film for use in a

semiconductor device that has small diameter pores and yet has a relative dielectric constant of about 2.5 or less, since large pores result in favorable dielectric constants but cause problems with respect to even trench formation, infiltration by unwanted materials, etc. (see paragraphs [0005-0007] of Fujita. Similar issues are addressed and solved by the present invention, but in an entirely different manner.

Fujita proposes three embodiments of solutions to this problem. In the Office Action, Examiner refers to paragraphs [0062-0063] and [0047] of Fujita, as well as Figure 2B. In so doing, Examiner has combined descriptions of two distinctly different embodiments of Fujita and arrived at an erroneous conclusion regarding the teachings of Fujita. Applicant has summarized and clarified the three embodiments of Fujita below.

Embodiment 1 of Fujita is described in paragraphs [0033-49], embodiment 2 is described in paragraphs [0050-0057] and embodiment 3 is described in paragraphs [0058-0069].

Embodiment 1. Fujita teaches a porous insulating film having a relative dielectric constant of 2.5 or less and including a first insulating material, at least a portion of pores in the porous insulating film having on the inner wall thereof a layer of a second insulating material which differs in nature from the first insulating material (see e.g. the abstract and claim 1). The porous insulating film of Fujita is thus comprised of two materials and is made using a two-step process. Briefly, [see paragraphs [0035-0039] as shown in Figure1A, a porous insulating film 2 is formed on a semiconductor substrate and having a relative dielectric constant of 2.5 or less. Unfortunately, as stated by Fujita, such films, with relative dielectric constants of 2.5 or less, have large pores with maximum diameters of 4 nm or more (paragraph [0037]; #3 in Figures 1A-B). This is undesirable and Fujita solves this problem be adding a step to the film forming method: an oxidation-reduction reaction is permitted to take place in the porous insulating film prior to forming a trench in the porous insulating film, thereby reducing the size of the pores to an optimum size by deposition of a layer of reaction product (a second insulating material) (paragraphs [0039-0044]; # 4 in Figure 1B).

Embodiment 2. Embodiment 2 of Fujita is similar to Embodiment 1 but the deposition of the second material within large pores is done after a trench is formed (see paragraphs [0051-0057]).

Embodiment 3. Embodiment 3 of Fujita involves a different sort of process. In this embodiment, a porous insulating layer with very small pores is first formed. However, the relative dielectric constant for this film is generally high (see below) and Fujita teaches that the diameter of the internal pores can be enlarged (e.g. from about 1nm or less to about 2-3 nm) by etching via irradiation (see paragraph [0065].

Examiner refers to paragraphs [0062-0063] of Fujita, allegedly to teach a porous insulating film with an average pore diameter of equal to or smaller that 1nm. In fact, these paragraphs describe embodiment 3 of Fujita. It is Applicant's position that Examiner has failed to take into account the context of those paragraphs, which are reproduced below for Examiner's convenience. Applicant draws Examiner's attention to the last sentence of paragraph [0063], which Applicant has underlined.

"[0062] Further, even when the porous insulating film 9 is formed by CVD method, very minute pores 10 having an average diameter of 1 nm or less may be formed in the porous insulating film 9, depending on the conditions to be employed. Namely, the conditions which enable the formation of such an insulating film are: where a plane-parallel plate plasma CVD apparatus is employed, 350 °C in film-forming temperature; 600/100/200 sccm in the ratio of trimethyl silane $SiH(CH_3)_3$/He/O_2; 4 Torr; and 400W in RF power.

[0063] In the case of this porous insulating film 9, since the average diameter of the pores 10 is very small, there would be little possibility of raising problems such as defective filling of a barrier metal even if the pores 10 exposes from the sidewall of the trench due to the aforementioned trench-forming work. Therefore, it is possible to form a wiring excellent in reliability. However, it would be impossible to sufficiently decrease the relative dielectric constant of the insulating film, thus the insulating film exhibits a dielectric constant of 2.5 or more."

To summarize, Fujita states that, while it is possible to make films with small pores, the resulting film has an unacceptably high dielectric constant. When making insulating films for semiconductor devices, the objective is to have small pores AND, according to Fujita, a dielectric constant less than 2.5. Thus, the film described in paragraphs [0062-0063] is the problem, not the solution.

Examiner has coupled paragraphs [0062-0063] with paragraph [0047] and Figure 2b as illustrating a porous insulating film having a distribution of pore diameter with a single peak and a specific inductive capacity equal to or greater than 2.1 and equal to or less than 2.7. This is incorrect in that Figure 2b relates only to paragraph [0047] and does not illustrate the results of the method taught in paragraphs [0062-0063], which is in fact depicted in Figures 6A and B. With reference to paragraph [0066], Figures 6A and 6B show the changes in distribution of pore size in a porous insulating film before and after the irradiation of EB, i.e. this is embodiment 3 of Fukita. Prior to irradiation, the pore size is indeed on average less than 1nm. However, in this film, as discussed above, the relative dielectric constant is also unacceptably high. Fujita's solution, according to embodiment 3, is to irradiate the film. After irradiation, the pores "have an average diameter ranging from about 2 to 3 nm as shown in FIG. 6B" (paragraph [0066] and as a result, the relative dielectric constant of the porous insulating film can be reduced to 2.5 or less.

The films shown in Figures 6A and B do not meet the requirements of claim 23. According to the teaching of Fujita, these films are formed from trimethyl silane, not from cyclic silica compounds (see paragraph [0062] above). In addition, the finished product of Fujita shown in Figure 6B has an average pore size of about 2nm, and a much larger pore size distribution, which is the point of Embodiment 3. Thus, claim 23 is not anticipated by this embodiment of Fujita.

With respect to Examiner's reference to paragraph [0047] and Figure 2b, this paragraph and this Figure relate to Embodiment 1. Figure 2B shows the end product of the practice of Embodiment 1, but that film differs substantially from that of claim 23 in that the film of Figure 2b of Fujita is comprised of two materials, one having been deposited in the large pores of the film, which does indeed reduce pore size, but which requires the extra step of deposition (see paragraph [0046]. Thus, claim 23 is not anticipated by this embodiment of Fujita.

Applicant further notes that no embodiment of Fujita uses cyclic silica compounds in the preparation of a film, and thus no film of Fujita would include pores enclosed within silica skeletons formed from polymerized cyclic organic silica molecules, as required in claim 23. For this, and for the other reasons detailed above, claims 23, 27 and 29 are not anticipated by Fujita.

Applicant notes that an important advantage of the present invention over Fujita (and over any other references cited herein) is that the goals of Fujita (small pore size but relative

dielectric constant less than 2.5) are accomplished in the method of the present invention simply by choosing an appropriate starting material (cyclic silica compounds with at least one unsaturated hydrocarbon group bound with a side chain of a skeleton) thereby eliminating the need for additional steps (e.g. deposition of a second layer of material to decrease pore size, etching to increase pore size, etc.). The method and films of the present invention are thus highly advantageous.

In view of the foregoing, Applicant respectfully requests reconsideration and withdrawal of this rejection.

Claim Rejections: 35 USC § 103(a): Examiner's Point #9

Claims 6, 7, 9, 11-16 and 19-21 stand rejected as obvious over a combination of Gates (as above) and Miyoshi (US2004/0253777). This rejection is traversed.

Firstly, Applicant notes that the section of the Office Action dealing with this rejection appears to contain irrelevant material, e.g. the sentence at the bottom of page 7 states "Regarding claim 11, Miyoshi et al. discloses a porous insulating film produced by the method of producing a porous insulating film according to claim 1 [0061] [0049-0050] [0064-0070]." Applicant notes that this appears to be an anticipation rejection rather than an obviousness rejection. Applicant further notes that the anticipation rejection of claim 1 based on Miyoshi was overcome by arguments presented in the response filed March 23, 2009, which responded to the Office Action mailed 12/24/2008. Briefly, Applicant showed that Miyoshi discloses only producing an insulator film by introducing material gas directly into the chamber without any dilution and proceeding with mixture and reaction with the excitation gas simultaneously on the substrate. In contrast, claim 1 requires the addition of a diluent gas in advance of formation of the film. Miyoshi does not anticipate the present invention as claimed in claim 1, and hence cannot anticipate the film of claim 11 which is made according to claim 1.

Secondly, it is Applicant's understanding that this rejection is based on an alleged combination of Gates and Miyoshi. However, in paragraph 3 on page 8 of the Office Action, Examiner refers to paragraph [0043] of Gates alone to ostensibly reject claim 14. Did Examiner intend to reject claim 14 based on alleged anticipation by Gates? Clarification is requested.

Thirdly, it is Applicant's understanding that this rejection is a rejection of claims 6, 7, 9, 11-16 and 19-21, yet paragraph 6 on page 8 deals with a rejection of claim 17 (which is not in

the list) and refers to Gates alone, i.e. no "combination" is invoked. Applicant has been unable to locate any other rejection of claim 17 in the present Office Action. Clarification is requested.

It is Applicant's position that no combination of Gates and Miyoshi renders the subject matter of claims 6, 7, 9, 11-16 and 19-21 obvious.

In view of the foregoing, Applicant respectfully requests clarification, reconsideration and withdrawal of this rejection.

Claim Rejections: 35 USC § 103(a): Examiner's Point #10

Claim 8 stands rejected as obvious over a combination of Gates (as above) and Miyoshi (as above). This rejection is traversed.

Contrary to Examiner's assertion, Gates does not teach all the limitations of claim 8 except specific cyclic organic silica compounds. Rather, as established above, Gates also does not teach the use of a diluent gas in the gas containing vapor of cyclic organic silica compounds. As also established above, Miyoshi does not provide this teaching, as the methods of Miyoshi do not involve the addition of a diluent gas to the gas containing vapor of cyclic organic silica compounds. Miyoshi is relied upon by Examiner only for the teaching of several cyclic organic silica compounds. Therefore, no combination of Gates and Miyoshi renders the present invention, as claimed in claim 8, obvious.

In view of the foregoing, Applicant respectfully requests reconsideration and withdrawal of this rejection.

Claim Rejections: 35 USC § 103(a): Examiner's Point #11

Claim 22 stands rejected as obvious over a combination of Gates (as above) and Miyoshi (as above). This rejection is traversed.

Claim 22 recites a semiconductor device with a porous insulating film which is made by the method of claim 2 (with intervening claims 18 and 31).As discussed above, Gates does not anticipate the subject matter of claim 2., failing to teach the addition of a diluent gas to the gas containing vapor of cyclic organic silica compounds. As also established above, Miyoshi does not cure this defect, and in fact is relied upon by Examiner only for the teaching of several straight chain organic silica compounds. Thus, the teaching of Miyoshi does not cure the defects of Gates, and no combination of Gates and Myoshi renders the subject matter of claim 22 obvious.

In view of the foregoing, Applicant respectfully requests reconsideration and withdrawal of this rejection.

Claim Rejections: 35 USC § 103(a): Examiner's Point #12

Claims 24-26 and 28 stand rejected as obvious over a combination of Fujita (as above) and Miyoshi (as above). This rejection is traversed.

Claims 24-26 and 28 all depend directly or indirectly on claim 23. As established above, and contrary to Examiner's assertions, Fujita does not anticipate the subject matter of claim 23. Claims 24-26 and 28 each delineate further features of the porous insulating film of claim 23 and Examiner relies on Miyoshi only to ostensibly teach those features (e.g. ratios of elements and particular silica compounds. Miyoshi thus does not in any way cure the defects of Fujita as a reference, and no combination of Fujita and Miyoshi renders the subject matter of claims 24-26 and 28 obvious.

In view of the foregoing, Applicant respectfully requests reconsideration and withdrawal of this rejection.

New claims

New claims 32-39 are hereby added for Examiner's consideration. Applicant submits that these new claims do not add new matter to the application, being fully supported, for example, in paragraphs [00522] - [0053] and [0033] of the application as published. Entry, examination and allowance of new claims 32-39 is respectfully requested.

Concluding Remarks

In view of the foregoing, it is requested that the application be reconsidered, that claims 1-39 be allowed, and that the application be passed to issue.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at 703-787-9400 (fax: 703-787-7557; email: ruth@wcc-ip.com) to discuss any other changes deemed necessary in a telephonic or personal interview.

If an extension of time is required for this response to be considered as being timely filed, a conditional petition is hereby made for such extension of time. Please charge any deficiencies in fees and credit any overpayment of fees to Attorney's Deposit Account No. 50-2041.

Respectfully submitted,

Ruth E. Tyler-Cross
Reg. No. 45,922

Whitham, Curtis, Christofferson & Cook, P.C.
11491 Sunset Hills Road, Suite 340
Reston, VA 20190
703-787-9400 (Telephone)
703-787-7557 (Facsimile)